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## ABSTRACT

Our understanding of the dynamics of HIV transmission in developing countries is compromised by unreliable data concerning sexual behavior. This paper represents an effort to investigate young people's reporting of sexual behavior. It summarizes the results from an interview-mode experiment conducted with unmarried young women aged 15–21 in rural southern Malawi in which respondents were randomly assigned to either an audio computer-assisted self-interview (ACASI) or a conventional face-to-face (FTF) interview. In addition, biomarkers were collected for HIV and three STIs: gonorrhea, chlamydia, and trichomoniasis. Prior to collecting the biomarkers, nurses conducted a brief face-to-face interview with participants in which they repeated questions about sexual behavior asked earlier. The paper builds on earlier research among adolescents in Kenya where we first investigated the feasibility and effectiveness of ACASI. In both Kenya and Malawi, clear evidence indicates that the mode of interviewing and probing concerning various sexual partnerships affects respondents' reporting of their sexual activity. Yet, the results are not always in accordance with expectations. Reporting for "ever had sex" and "sex with a boyfriend" is higher in the FTF mode. When we ask about other partners as well as multiple lifetime partners, however, the reporting is consistently higher with ACASI, in many cases significantly so. As in Kenya, in Malawi the interview-administered mode produced more consistent reporting of sexual activity between the main interview and a subsequent interview. Finally, the association between infection status and reporting of sexual behavior is stronger in the FTF mode, although in both modes, some young women who denied ever having had sex tested positive for STIs/HIV.

Our understanding of the dynamics of HIV transmission in developing countries is compromised by unreliable data on sexual behavior. Epidemiological studies in Africa have observed little association between self-reported risky sexual behavior and HIV status. Indeed, a large multisite study of factors determining HIV prevalence in four African cities revealed considerable numbers of women who were HIV-positive yet reported themselves to be virgins or reported having only one sexual partner and few episodes of sexual intercourse (Buvé et al. 2001; Glynn et al. 2001).

The inconsistency between reported sexual behavior and HIV incidence has prompted some epidemiologists to question the conventional explanation for the African AIDS pandemic. Arguing that preconceived notions of African sexuality have unduly influenced researchers, several epidemiologists suggest that parenteral transmission via medical injections with contaminated needles rather than risky sexual behavior has played a substantial role in the spread of HIV (Brewer et al. 2003; Gisselquist et al. 2003; Gisselquist and Potterat 2003).<sup>1</sup> Some anthropologists also have been critical of the standard interpretations for the African pandemic. In a recent critique of explanations for trends in HIV transmission in Uganda, Tim Allen (2006:14) argues that “much of what has been claimed [about sexual activity] is based on little more than speculation, and is sometimes affected by very misleading assumptions about a homogeneous African sexuality.” He also faults AIDS researchers for focusing on high-risk behavior and neglecting nonsexual transmission.

Surprisingly, the epidemiologists who challenge conventional wisdom about the AIDS pandemic in Africa are not similarly skeptical about the survey data concerning sexual behavior that are used to buttress their arguments. Gisselquist and Potterat (2003:171) assert: “[T]he care with which these [surveys] . . . have been performed, the familiarity of investigators with local conditions, their experience in the conduct of such studies, and the consistency of response make summary dismissal of such results untenable.” The willingness of these researchers to accept survey data of questionable validity has serious implications for interpretations of the etiology of HIV transmission.

Researchers who rely on survey data are more suspicious of the information they collect than are the epidemiologists cited above. With regard to the sexual behavior of adolescent girls in sub-Saharan Africa—the subject under investigation here—it is reasonable to expect that a substantial number of young women would find great difficulty admitting to an interviewer that they have had sex outside of a socially sanctioned relationship (Dare and Cleland 1994). Throughout much of the region, the Catholic Church and evangelical Protestant churches have a prominent role in the lives of the population, premarital abstinence is increasingly promoted, and the discovery of a pregnancy often means the girl’s expulsion from school.

Watkins and her colleagues (2003) have observed that a well-designed and carefully followed data-collection process does not guarantee that good data will be obtained. Despite attention to questionnaire development and to selection, training, and supervision of interviewers in their own surveys in Kenya and Malawi, they found evidence of “patron–client relations, respondent autonomy and interviewer autonomy,” all of which undermine data quality.<sup>2</sup> They advocate that “research not only attempt to uncover systematic biases in the data but also that a description of data collection procedures and evaluation of data quality become a routine expectation for research articles” (pages 27–28).

Researchers have examined the reliability and validity of survey data collected in developing countries (Blanc and Rutenberg 1990; Lagarde et al. 1995; Blanc and Way 1998; Eggleston et al. 2000; Curtis and Sutherland 2004; Gregson et al. 2004; Nnko et al. 2004; Zaba et al. 2004). Although many acknowledge that the reporting of sexual behavior is problematic, few have investigated the ways in which the data-collection process may be flawed and explored techniques to improve it. Gregson and his colleagues (2002) and Plummer and colleagues (2004), together with the researchers who have conducted the interview-mode experimental studies described below, are notable exceptions.

In 2003, a technical meeting on “Measurement of Trends in Sexual Behaviour,” co-sponsored by the London School of Hygiene & Tropical Medicine, UNAIDS, the World Health Organization (WHO), and the MEASURE Project, was convened to review the quality of data used to assess trends in sexual behavior in the context of the HIV pandemic and to examine various methodologies to collect sexual behavior data in surveys. Although the goal was to develop recommendations for monitoring trends in sexual behavior, no simple guidelines emerged (see Cleland et al. 2004). The takeaway message from the meeting was that more studies must be conducted before definitive claims can be made about the best way to collect data on sexual behavior.

This paper represents an effort to investigate the reporting of sexual behavior in a developing country survey. It summarizes the results from an interview-mode experiment conducted among unmarried adolescents in a rural district of southern Malawi. Data on sexual behavior generated from audio computer-assisted self-interviewing (ACASI), a technique designed in the United States to collect information about sensitive issues, are compared with data generated from conventional face-to-face (FTF) interviews. The paper builds on earlier research conducted in two districts in Kenya where we first investigated whether use of ACASI is feasible in developing countries and whether it is a superior method of data collection to interviewer- and self-administered questionnaires (Mensch et al. 2003; Hewett et al. 2004a and 2004b). Although the software and hardware performed well in Kenya, and ACASI was found to elicit higher reporting for many questions on sensitive behavior, some anomalies emerged that raised questions about the effectiveness of computerized interviewing for reducing measurement error in developing country surveys.

One of the limitations of our Kenya study was that we could determine only if reporting in the two interview modes differed statistically from each other. For the Malawi analysis presented here, we use biomarkers of STIs and HIV to investigate the strength of the association between STI/HIV status and risky sexual behavior according to interview mode. Although we are aware of the limitations and difficulties of using biomarkers to assess reporting of sexual behavior (Catania et al. 1990; Fishbein and Pequegnat 2000; Fenton et al. 2001), we believe that when they are collected in tandem with an experimental assignment to interview mode, they can provide important supplementary data for evaluating interviewer-mode effects.

## **LITERATURE REVIEW: THE REPORTING OF SEXUAL BEHAVIOR WITH ACASI**

The computerized administration of questionnaires, developed in part to address concerns about the influence of interviewers in surveys, hypothesizes that the more private and standardized the interview, the better the quality of the data. With ACASI, software is designed

so that the respondent hears both the question and the response categories through headphones. The respondent answers each question by pressing a number on a keypad or computer keyboard. The advantage of ACASI over FTF interviews is that neither the investigator nor anyone else in the area where the interview is being conducted hears the question or the response, thus reducing social desirability bias. Moreover, unlike self-administered interviewing, which requires that the respondent be literate and competent to fill out a questionnaire, ACASI can be used without the respondents' having to read the questions on the computer screen.<sup>3</sup> Additionally, the researcher does not have to be concerned with differences in the characteristics or interviewing styles of the interviewers (Tourangeau et al. 2000). In situations where respondents are forthcoming about sensitive behaviors, however, removing the interviewer may have consequences for data quality, because a competent interviewer can probe, assist with recall, and resolve inconsistencies.

ACASI has been used successfully in United States surveys, including the National Survey of Family Growth, the National Survey of Adolescent Males, and the National Longitudinal Study of Adolescent Health. Data have been collected on the use of injectable drugs, abortion, same-gender sex, and violent behavior—with significantly higher levels of these behaviors reported than in face-to-face interviews and paper-and-pencil self-administered questionnaires, although ethnic differences in the degree of respondents' comfort with the computer have been noted (Tourangeau and Smith 1996; Turner et al. 1997; Fu et al. 1998; Turner et al. 1998; Hewitt 2002). ACASI also has been used successfully in specialized surveys of gay men, injecting drug users, and women at high risk of HIV exposure (Des Jarlais et al. 1999; Gross et al. 2000; Metzger et al. 2000). Randomized assignment of respondents to either ACASI or face-to-face interviews revealed greater reporting of HIV risk behaviors with the computer (Des Jarlais et al. 1999; Metzger et al. 2000), with greater differences being observed among HIV-positive than HIV-negative respondents (Macalino et al. 2002).

A commentary in *Science*, summarizing the results of an experiment conducted in the United States comparing ACASI with self-administered questionnaires, argued that ACASI may be especially suited to collecting data in developing countries, “where overcrowded living conditions typically prevail, where literacy is relatively low, and where some of the behaviors in question may be particularly pronounced” (Bloom 1998:847). In the past five years, a number of studies have investigated the use of ACASI in developing countries. The results from this research are not as definitive, however, as the results from the interview-mode experiments in the United States.

One of the first experiments conducted outside the United States was carried out at a college in Thailand; it compared self-administered questionnaires with ACASI. Substantial differences in responses were found according to interview mode: ACASI produced more reports of sexual activity, particularly for females, although the sample was too small for these differences to be statistically significant. The researchers' use of automated skip patterns with ACASI reduced measurement error (Rumakom et al. 1999). A more recent randomized experiment in Thailand was conducted among a sample of more than 1,200 students aged 15–21. The study compared palm-top assisted self-interviewing (PASI) with ACASI, self-administered, and face-to-face interviewing and found that PASI was comparable to ACASI and self-administered questionnaires and superior to face-to-face interviews with regard to self-reports of the most sensitive sexual behaviors. Moreover, the association of tobacco smoking as reported by

the respondent with a biomarker for nicotine metabolites in urine was stronger in PASI and ACASI than in face-to-face interviews (van Griensven et al. 2006).

A study in Mexico assessed differences in the reporting of induced abortion by women aged 15–55 who were randomly assigned to one of four interview methods: ACASI using a touch screen, face-to-face interviews, self-administered interviews, and a random-response technique. For the random-response technique, a woman was asked to put her hand in a bag that contained two folded sheets of paper, one asking whether she was born in April and the other asking whether she had ever had an abortion. The interviewer did not know which sheet the woman chose. The methods were tested among three populations: hospital patients in Mexico City, women in a rural area, and women in a household sample in Mexico City. For all three populations, the highest reported rate of abortion was found with the random-response technique, followed by the self-administered questionnaire. Reporting among those assigned to ACASI and face-to-face interviews was lower (Lara et al. 2004).<sup>4</sup>

Two experimental studies with random assignment have been conducted more recently in Asia, one in Pune, India, among unmarried male college students and slum dwellers, and another in Vietnam among a large household-based sample of adolescents in a suburb of Hanoi. In India, reporting of sensitive sexual behaviors was generally higher among college students assigned to ACASI, compared with those assigned to face-to-face or self-administered questionnaires. The results for young slum dwellers were much less consistent, which led the authors to question the efficacy of computerized interviewing among the less-educated (Potdar and Koenig 2005). In Vietnam, the reporting of sensitive behavior was significantly higher among young men assigned to ACASI, but not among young women (Linh et al. 2006).

Our research in Kenya employed an experimental design to investigate whether ACASI produced reporting of sexual activity and related behaviors of greater validity than did FTF interviews or self-administered interviews among more than 6,000 unmarried adolescents aged 15–21 in two districts. The results for girls from the first district, Nyeri, were inconsistent with expectations. In response to the initial “ever had sex” question, girls interviewed with the computer were less likely to report that they had had sex, compared with those interviewed face-to-face. Boys interviewed with ACASI were also less likely to report having had sex, but that was an expected finding, because we assumed that boys exaggerate in FTF interviews. For the second district, Kisumu, we altered the skip pattern of the questionnaire. Regardless of the response to the first question, respondents were asked a subsequent series of questions about sexual partners and coerced sex. For most of these additional questions, which ask about more stigmatized behavior, reporting was higher among both boys and girls when the computer was used (Mensch et al. 2003).

A more focused analysis of consistency in the reporting of sexual behavior among adolescent girls in Kisumu revealed that ACASI respondents were much less likely than those interviewed face to face to provide consistent answers. For example, only three of 181 young women interviewed face to face who reported never having had sex in response to the first question about sexual behavior indicated that they had had sex in response to questions about various types of partners and experience of coerced sex.<sup>5</sup> In contrast, among the ACASI group, 83 of the 174 respondents who reported never having had sex subsequently reported having had sex in answer to the partner and coerced-sex questions. Based solely on the initial question of age

at first sex, 48 percent of the interviewer-administered group reported having had sex, compared with 43 percent of the ACASI group. When we recomputed the proportion who had ever had sex based on all of the sexual behavior questions, the interviewer-administered group barely changed (49 percent), whereas the ACASI group increased to 68 percent. We concluded that ACASI produced a more diverse picture of adolescent sexual activity than FTF interviews. We also concluded that the consistency in the FTF interview mode was suspect, particularly given the much lower levels of reporting, relative to ACASI, for types of sexual partners and coerced sexual activity (Hewett et al. 2004b).

#### **DATA COLLECTION AND SAMPLE**

The ACASI experiment described here was an ancillary study to the 2004 wave of the Malawi Diffusion and Ideational Change Project (MDICP), a panel survey of ever-married women of childbearing age and their husbands to which an adolescent sample was added. The MDICP assesses behavioral responses to perceived and actual HIV/AIDS risk, with a conceptual focus on the role of social interactions in mediating information flows.<sup>6</sup> The first MDICP survey was conducted in 1998 in rural areas of three districts of Malawi, one in each administrative region of the country, Rumphi in the north, Mchinji in the center, and Balaka in the south. Although the MDICP survey was not designed to be representative of rural Malawi, the sample characteristics are similar to those of the rural areas represented in the 1996 Malawi Demographic and Health Survey (Watkins et al. 2003). A second round of the survey was conducted in 2001 and the third in 2004. For the third wave of data collection, approximately 1,500 unmarried and married males and females aged 15–24 were added to the study population; participants of all ages were tested for HIV, chlamydia, and gonorrhea, and the women were also tested for trichomoniasis.

The data for the ancillary study come from interviews conducted in June and July of 2004 among a supplementary sample of 501<sup>7</sup> unmarried female adolescents mostly aged 15–21<sup>8</sup> in rural areas of Balaka District. Balaka was selected because it lies in the region of the country with the highest reported rates of HIV infection (UNAIDS 2004), teenage pregnancy, risky sexual behaviors, and early sexual initiation (National Statistical Office [Malawi] and ORC Macro 2001). Although the Chewa are the most populous ethnic group in Malawi, the dominant group in Balaka is the Yao. More than half of the adolescents in our sample are Yao, 15 percent are Chewa, nearly 20 percent are Ngoni, and the remainder identify with a variety of other tribes. Like the Chewa, the Yao speak a Bantu language and follow a matrilineal system of inheritance. The Ngoni, who migrated from South Africa at the beginning of the nineteenth century, were originally patrilineal with patrilocal marriage. Because they have intermarried with matrilineal groups, however, they have not retained their original customs. Moreover, because of contact with other groups, they no longer speak a Zulu dialect; virtually all of the Ngoni in our sample speak Chichewa. Unlike the Chewa and Ngoni, who are almost all Christian, the Yao are primarily Muslim, their ancestors having come into contact with Arab/Swahili slave traders in Mozambique during the nineteenth century (Tew 1950).

The adolescents in our sample resided in villages contiguous to trading centers near the villages included in the main MDICP. Trading centers in rural Malawi consist of small centralized market areas and are typically situated along major roadways. The villages adjacent

to trading centers are more densely populated than remote rural villages and were chosen because of the greater likelihood of finding adolescents, who are typically more mobile than the adult population. Nonetheless, despite our efforts, the response rate was not high. Of the 707 adolescents in our household listing, 501 were interviewed successfully, a response rate of 71 percent. We have no way of knowing whether those who were interviewed differed markedly from those who were not, because household information was not included systematically in the listing form. The MDICP household form was used only for determining eligibility. As for the characteristics of the households in our sampled communities, few had access to electricity or piped water, and homes were typically made of sun-dried brick covered with mud and thatched roofs. The primary economic activity in these communities is subsistence agriculture.

## **STUDY DESIGN**

Respondents were randomly assigned to either a complete face-to-face interview or a FTF/ACASI combination interview. The questionnaire for the experimental substudy was the same as that used for the adolescent sample in the MDICP survey. The 12 sections of the questionnaire were divided by topic; the sexual behavior questions were in section 6. For ACASI respondents, all sections except for the sexual behavior questions and a small set of sensitive questions from the HIV/AIDS section were administered face to face by an interviewer. To further minimize the effect of interviewer characteristics, all interviewers were female and trained in both interview methods; respondents were randomized to an interviewer and to an interview mode.

After an introduction that reiterated the confidentiality of the interview and the purpose of collecting sensitive information, the sexual behavior section began with a question on age at first sex and continued with questions about different types of sex partners (person the respondent was expected to marry [“expected spouse”], boyfriend, friend or acquaintance, relative, teacher, employer, or stranger). As in our Kisumu, Kenya study, the follow-up partner questions were asked regardless of the response to the initial sexual behavior question. If a respondent indicated that she had had sex with a particular partner, she was asked the age at which she first had sex with that partner. Additional questions included the total number of lifetime sexual partners, and whether the respondent had had sex in the past 12 months. If respondents replied that they had had any sex partners, they were asked a series of questions about their two most recent partners, including frequency of sex, duration of the relationship, marital status of the partner, educational level of the partner, and condom use, including ever use, use at last sex, and frequency of use.

After being interviewed, respondents were asked whether they would be willing to be tested for HIV and STIs. Consent was requested separately for HIV and the STIs, and parental permission was obtained for those adolescents younger than 18. Testing for STIs typically occurred within one week of the survey and was conducted by trained nurses. Prior to collection of the biomarkers, each respondent was interviewed by the nurses and asked again the series of questions about sexual behavior, including age at first sex, number of sex partners, sex in the past 12 months, relationship to current or most recent sexual partner, condom use at last sex, whether she had overlapping partners, and whether she had been tested for HIV. These questions enable us to perform test–retest comparisons of the consistency of responses by interview mode.

Respondents provided vaginal swabs for gonorrhea, chlamydia, and trichomoniasis. Collected specimens were analyzed by Roche Polymerase Chain Reaction (PCR) tests. HIV status was determined by use of the OraSure<sup>®</sup> ELISA test on oral samples; positive samples were retested using the OraSure<sup>®</sup> Western Blot test. The biomarkers were analyzed at a laboratory supervised by the University of North Carolina, Chapel Hill, at Lilongwe Central Hospital. To preserve confidentiality, the specimens were given a unique biomarker identification number; this number was also recorded on a Polaroid<sup>®</sup> photograph taken by the nurse conducting the test and given to the respondent. No personal identifiers were included on the specimens.

The MDICP team found that, for the most part, respondents were receptive to the idea of being tested; in some villages in Balaka where the ACASI study was conducted, however, the response was not as enthusiastic, and occasionally nurses were referred to as “bloodsuckers” (Anglewicz et al. 2005). Of the 501 respondents in our sample, 399 (80 percent) provided at least one biomarker, 376 provided biomarkers for all four, and 14 were not tested for trichomoniasis. Because the testing rate was not as high as expected, either in the ACASI sample or in the main MDICP sample, respondents who had not been tested originally were contacted again for HIV testing in November, approximately four to five months after their initial interview. An additional 22 respondents were tested for HIV after recontact. In total, 421 or 84 percent of respondents provided one or more biomarkers. This proportion is comparable to the proportion of female adolescents who were tested in the larger MDICP sample. For MDICP, 83 percent provided STI samples and 90 percent provided HIV samples (Thornton et al. 2005).

Although the MDICP protocol indicated that results were to be communicated to respondents between five and seven weeks after testing at voluntary counseling and testing (VCT) sites set up in portable tents in locations central to the sampled villages, in Balaka District respondents did not receive their results until November. This delay was the result of a shortage of reagents for the various tests.<sup>9</sup> The nurses were provided with a list of biomarker ID numbers with corresponding test results but no other identifying information. The Polaroid photos given to respondents previously had to be presented to a VCT counselor in order to obtain the results. Respondents who tested positive for any of the STIs were treated at the site at no cost.<sup>10</sup> Respondents who tested positive for HIV were referred to the nearest district hospital for care and treatment options.<sup>11</sup>

#### **ACASI TECHNOLOGY AND DESIGN**

A customized ACASI program was developed for data collection using Microsoft Visual Basic programming and Access database software. The respondent used audio headphones to listen to the questions and response options. A choice of languages was offered; 18 percent of ACASI respondents listened to the questions in Yao and 82 percent in Chichewa.<sup>12</sup> The respondent answered the questions via an external mini-keypad with several color-coded keys: a red key to replay the question, a green key to go on to the next question, and a yellow key to skip a question. For dichotomous questions, respondents pressed 1 for “yes” and 2 for “no.” For questions requiring a numeric response, such as age, they entered the number. During the ACASI interview, the computer remained closed and was kept in a carrying case. Thus the respondent did not read the questions. This decision to rely entirely on audio presentation of questions was made because of concern about the level of respondents’ literacy and to afford them greater

privacy, especially because computers are novel in rural Africa and attract attention (Hewett et al. 2004a).

## RESULTS

As noted above, respondents were randomly assigned to the two interview modes, FTF and ACASI. In light of the size of the sample, however, the two groups might differ in ways that could affect the distribution of reporting of sensitive behavior. Table 1 compares the characteristics of respondents for each interview mode across a set of individual and household characteristics. Although some marginal differences are found between the two groups—those in the ACASI group are older, slightly more educated, (although less likely to be currently attending school), more likely to be Muslim and religiously observant, and less likely to live with both parents—only three indicators are statistically significant.

### Reporting of premarital sex by interview mode

To evaluate differences in reporting of premarital sexual behavior statistically by interview mode, in Table 2 we present predicted percentages derived from logistic regression models that

**Table 1** Characteristics of study sample, by interview mode, Malawi, 2004

Characteristic	Face-to-face interview (FTF)	Audio computer- assisted self- interview (ACASI)
<b>Sample size (N)<sup>a</sup></b>	(275)	(226)
<b>Respondents' characteristic</b>		
Age	16.5	16.8†
Years of schooling (range: 0–12)	6.9	7.2
Currently enrolled in school	64.5	61.0
Ethnicity: Yao	53.0	54.9
Muslim	44.3	52.6†
Attends religious services at least once per week	64.3	69.6
Born again (Christian)/made tauba (Muslim)	28.6	36.9*
<b>Household characteristic</b>		
Lives with both parents	40.7	34.5
Lives with mother	47.6	45.1
Older male peers in household <sup>b</sup>	22.5	21.7
Older female peers in household <sup>b</sup>	25.5	23.5
Number of people slept in household previous night	5.9	6.1
Number of consumer durable items owned <sup>c</sup>	5.4	5.3

† Significant at  $p < 0.10$ ; \* $p < .05$ .

<sup>a</sup> Sample for each variable may differ as a result of missing values.

<sup>b</sup> Older peers are defined as being between one and five years older than the respondent.

<sup>c</sup> Consumer durables include: furniture, television, radio, telephone, mosquito nets, solar panels, bicycle, motorcycle, car, hoe, and oxcart.

control for background variables. Multivariate models were estimated to capture any heterogeneity in reporting of sexual behavior according to respondents' known characteristics.<sup>13</sup> Because the study design, sample, and questionnaires were similar for our previous study conducted in Kenya, we provide the results for a selection of questions where direct comparisons could be made.

**Table 2** Predicted percentages of sexual behaviors, by interview mode and country, Malawi, 2004, and Kenya, 2002

Sexual behavior <sup>a</sup>	Balaka, Malawi		Kisumu, Kenya <sup>b</sup>	
	FTF	ACASI	FTF	ACASI
Ever had sex	<b>47.9**</b>	34.8	<b>48.3</b>	42.8
Ever had sex with:				
Boyfriend	<b>30.9**</b>	21.0	<b>45.7</b>	40.1
Expected spouse	27.5	<b>29.4</b>		
Friend or acquaintance	6.8	<b>17.1**</b>	9.8	<b>31.9**</b>
Family member	1.3	<b>7.1†</b>	1.0	<b>20.9**</b>
Stranger	2.5	<b>3.3</b>	3.7	<b>13.9**</b>
Teacher	1.0	<b>1.8</b>		
Employer	1.0	<b>3.8†</b>		
Composite: Sex with any partner <sup>c</sup>	47.4	<b>50.7</b>	48.0	<b>61.0**</b>
Composite: Ever had sex or had sex with any partner <sup>c</sup>	48.3	<b>57.8*</b>	48.9	<b>67.5**</b>
More than one sexual partner in lifetime	16.5	<b>27.2**</b>	20.7	<b>34.9**</b>

†Significant at  $p < 0.10$ , \* $p < 0.05$ ; \*\* $p < 0.01$ ; represents significance of interview-mode variable in logistic regression, controlling for background characteristics.

<sup>a</sup> A full set of individual and household background variables was used in generating predicted values.

<sup>b</sup> Sources: Hewett et al. (2004b) and Mensch et al. (2003).

<sup>c</sup> Response for this item not strictly comparable for Balaka and Kisumu because of different sexual partner listings and because the percentages for Kisumu include coerced sex.

In the first row of Table 2, a respondent is considered to have “ever had sex” if she provided a numeric answer in response to the initial sexual behavior question: “How old were you the first time that you had sex?”<sup>14</sup> The next set of outcomes is based on questions regarding sex with particular types of partners. Two different composite measures are presented in the table. The first is coded 1 if the respondent answers “yes” to any of the individual partner questions. The second composite measure, which is our most inclusive indicator of premarital sex, is coded 1 if the respondent provides an age for the initial age-at-first-sex question or answers “yes” to any of the individual partner questions.<sup>15</sup> Finally, for comparative purposes, we present a measure of multiple lifetime partners. On the right-hand side of the table, we present the results from our Kenya study, which, like the experiment conducted in Malawi, was limited to unmarried adolescents aged 15–21. In Kenya, however, the initial question asked was: “Have you ever had sexual intercourse?”

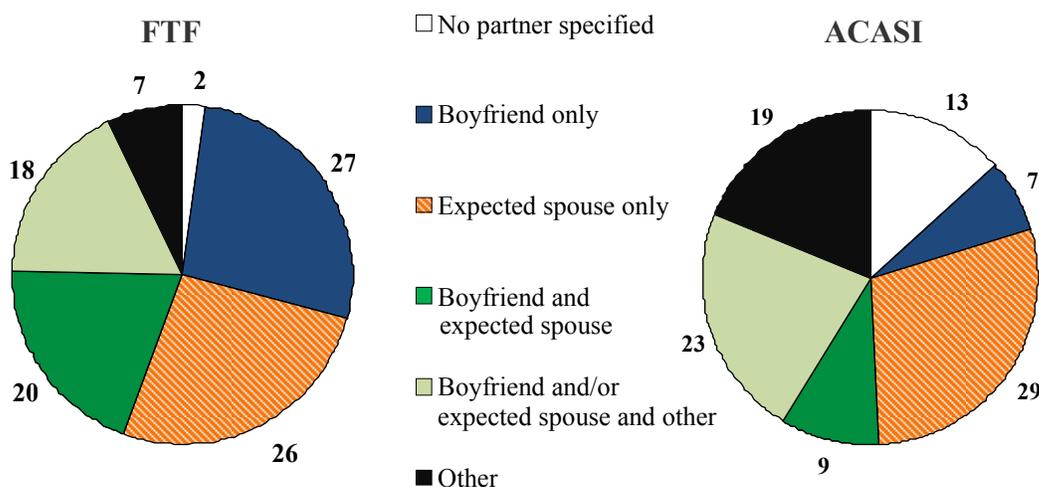
The percentages shown in boldface type indicate which mode has the higher percentages for each behavior. Although a large difference is found in the initial question of ever had sex by interview mode, the difference is not in the expected direction. In Malawi, nearly half the FTF

sample report ever having had sex, compared with slightly more than one-third of the ACASI sample. In Kisumu, the difference between the two groups is not as large, but it is in the same direction as in Malawi; 48 percent of the FTF group report ever having had sex, compared with 43 percent in the ACASI group. We are as puzzled by this result in Malawi as we were by the result in Kenya, and return to it after discussing the results from the partner questions.

Aside from the response to the question on sex with a boyfriend, for which the pattern is similar to that observed for the age-at-first-sex question, the answers to the partner questions are more in line with our expectations; ACASI produces higher percentages, and in the cases of sex with a friend, a family member, or an employer, significantly higher percentages. ACASI respondents are also significantly and substantially more likely to report more than one lifetime sexual partner. The differences in reporting by mode are similar in the two samples, although—with the exception of multiple sexual partners, where the proportionate increase in ACASI reporting is nearly equivalent in both settings—stronger in Kisumu than in Balaka.

Using the various partner questions, we can derive a measure of the composition of sexual partners that a respondent has had. This computation is performed for our Malawi sample in Figure 1. As the figure indicates, the composition of sex partners differs markedly for the two interview groups. Whereas the vast majority of FTF respondents report having had sex with a boyfriend and/or expected spouse only, with only one-fourth reporting ever having had sex with one of the other types of partners, more than 40 percent of ACASI respondents report ever having had sex with one of the other types of partners. Moreover, ACASI respondents are more likely than FTF respondents (13 percent versus 2 percent) to report having had sex without specifying type of partner.

**Figure 1** Composition of types of sexual partners among respondents reporting that they had ever had sex (percent), by interview mode, Malawi, 2004



Comparing the initial responses to the ever-had-sex question with the two composite measures in the FTF mode, the proportion reporting sexual experience changes minimally for the measures of sexual activity from 48 to 47 to 48 percent. The results for ACASI are notably different. Although only 35 percent of ACASI respondents report ever having had sex based on the initial question, the proportion increases to 51 percent when sex with specific partners is included. When both sets of questions are used, the proportion increases to 58 percent, which is significantly higher than the proportion reporting ever having had sex in the interviewer-administered mode. In the FTF mode, only four of 275 respondents were inconsistent across the two measures of sexual activity. In contrast, in ACASI, 69 of 226 respondents were inconsistent: 52 (35 percent) respondents who indicated they had never had sex when asked the initial question subsequently indicated that they had had sex with a specific partner, and 17 (22 percent) respondents who indicated they had had sex in answer to the initial question subsequently did not respond affirmatively to any of the partner questions.

We observe a similar pattern in Kisumu. When the partner-specific questions were asked, the proportion reporting that they had ever had sex changed little among young women in the FTF group, remaining at 48–49 percent, but it increased markedly in the ACASI group from 43 percent to 61 percent and to 68 percent for the most inclusive measure.

The question arises as to whether the discrepancy in response to the initial question on sex and the more detailed follow-up questions is more common among certain adolescents than others. The literature on inconsistency in responses, which focuses primarily on adolescents, indicates that discrepancies in reporting are not random. Rates of inconsistency are reported to vary by respondents' characteristics, such as sex, education, cognitive ability, and race. Analyses of self-reports of sexual activity in large nationally representative longitudinal surveys of adolescents in the United States indicate that black males tend to be the most inconsistent and white females the most consistent (Lauritsen and Swicegood 1997; Upchurch et al. 2002), although studies based on smaller, more selective samples have produced conflicting findings with regard to race and sex (see Rodgers et al. 1982 and Alexander et al. 1993). For both sexual behavior and substance use, the proportion whose reporting is inconsistent is higher among those with lower levels of schooling, lower scores on cognitive tests, and lower grade-point averages (Bachman and O'Malley 1989; Fendrich and Vaughn 1994; Upchurch et al. 2002). Multivariate analyses of inconsistent reporting of sexual behavior and drug use indicate that racial differences persist after controlling for other socioeconomic characteristics (Fendrich and Vaughn 1994; Lauritsen and Swicegood 1997; Upchurch et al. 2002). Some analysts suggest that minorities may have less trust in the interview process or feel more intimidated by it (Mensch and Kandel 1988; Fendrich and Vaughn 1994).

We investigated the covariates of inconsistent reporting between the first question on age at first sex and subsequent questions on partners, although this investigation was implemented only for the ACASI group because so few FTF respondents provided discrepant answers. The results (not shown) from logistic regression models using the demographic and household variables in Table 1 did not reveal any systematic associations with inconsistent reporting. None of the theoretically expected demographic variables—age, years of education, current school enrollment, ethnicity, religion, religious observance—was significant. The only variables that appear to have an effect are those measuring household structure, although the reason for this

effect is not clear; having older male peers in the household raises the likelihood of an inconsistent response, whereas having older female peers lowers that likelihood. Moreover, in some models, the greater the number of people in the household, the lower the likelihood of an inconsistent response.

In an earlier paper based on our Kisumu data, we speculated about the inconsistency between responses to the initial ever-had-sex question and the subsequent partner questions in ACASI (see Hewett et al. 2004b and Mensch et al. 2003). Because the same pattern is observed here, reviewing and expanding on the possible explanations that we provided in our earlier studies is worthwhile:

- (1) If a respondent replied that she has never had sex when asked about her age at sexual initiation, the interviewer may not have asked subsequent questions. Although interviewers were trained to ask every question regardless of the answer to the initial age-at-first-sex question, we do not know whether they followed the specified procedures, especially in light of a recognized tendency among interviewers to complete each interview as quickly as possible.
- (2) Young women in the FTF mode originally may have answered “no” to the age-at-first-sex question but subsequently replied affirmatively when asked whether they have had sex with specific partners. The interviewer may have returned to the first question at that point and changed the answer. Although this reconciling of responses may have occurred, we explained to the interviewers that we expected inconsistent responses and instructed them not to change answers.
- (3) ACASI respondents may have compartmentalized specific sexual behaviors and not regarded sex with certain partners as the type of behavior being asked about when queried about their age at sexual initiation. In the FTF mode, respondents may not have been given the opportunity to respond to questions about partners if they initially denied having had sex (see number 1 above), or interviewers may have gone back and changed their original response (see number 2 above).<sup>16</sup>
- (4) In denying ever having had sex when responding to an interviewer, a participant in the FTF group is unlikely to contradict herself and report having had sex with a particular partner in answering a subsequent question, even if she would like to update her answer. An ACASI respondent might be less concerned with providing contradictory responses.

Unfortunately, in the absence of further data collection, we cannot give one of these explanations precedence over another. Not only might we benefit from in-depth interviews with respondents about the interviewing process in both the FTF and ACASI modes,<sup>17</sup> we also need to acquire a better understanding of how interviewers conduct such interviews, perhaps by taping a subset of interviews or by doing a better job of debriefing interviewers in the field.

### **Consistency in reporting between the nurse’s interview and the main interview**

Prior to the collection of STI/HIV biomarkers, the nurses asked respondents several questions about their sexual behavior in a face-to-face interview. Some of these questions were a subset of those asked in the main interview and were worded similarly. These data allow for an

FTF/FTF and ACASI/FTF comparison of responses between the main and the nurse’s interview. If our assumption about the reporting of premarital sex in a computerized interview is correct, a higher percentage of ACASI respondents reporting sexual activity in the main interview would deny having had sex in answers to questions in the subsequent FTF interview. Of course, respondents may, in fact, feel less timid or more comfortable reporting their sexual behavior to a health professional, such as a nurse. In this case, more frequent reporting might be expected from the nurse’s interview.

Table 3a compares the reporting of the proportion who provided an age in response to the question “How old were you the first time you had sex?” in the nurse’s interview with the proportion who provided an age in response to the same question in the main interview. Respondents could have initiated sex in the time between the main interview and the nurse’s interview, although this circumstance would be unlikely because typically only one week elapsed between interviews. As the table shows, a greater proportion of inconsistent (off-diagonal) responses are given in ACASI than in the FTF mode (28 percent  $[(47 + 5) \div 183]$  versus 13 percent  $[(24 + 7) \div 231]$ ). We expected that, compared with those in the FTF mode, a greater proportion of those who answered “yes” in the main interview in ACASI would subsequently deny having had sex when interviewed by the nurse. Although the proportion is larger—8.5 percent versus 6.5 percent—the difference is much smaller than anticipated. Moreover, among those who reported in the main interview that they had not had sex, a much higher proportion of ACASI than FTF respondents reported that they had had sex when interviewed by the nurse. Table 3b compares the reports of the proportion who provided an age in response to the question “How old were you the first time you had sex?” in the nurse’s interview with the proportion who reported in the main interview that they had had at least one type of sexual partner.<sup>18</sup> Although the results for this comparison are more in line with expectations in that a much larger proportion of ACASI respondents who answered “yes” in the main interview deny ever having had sex in their responses to the nurse’s interview (18.0 percent versus 7.4 percent), we find, nevertheless, that about the same proportion of ACASI “deniers” in the main interview report ever having had sex when a nurse asks the question (23.8 percent versus 19.5 percent).

**Table 3a** Comparison of percentage distribution of respondents reporting in the main interview and the nurse’s interview that they had ever had sex, based on responses to the question about age at first sex , by interview mode, Malawi, 2004

	FTF (n = 231)				ACASI (n = 183)			
	Main interview				Main interview			
	No		Yes		No		Yes	
Nurse’s interview (FTF)	%	(n)	%	(n)	%	(n)	%	(n)
No	80.6	(100)	6.5	(7)	62.1	(77)	8.5	(5)
Yes	19.4	(24)	93.5	(100)	37.9	(47)	91.5	(54)

**Table 3b** Comparison of percentage distribution of respondents reporting that they had ever had sex, based on responses to type-of-partner questions in the main interview and age-at-first-sex question in the nurse’s interview, by interview mode, Malawi, 2004

	FTF (n = 249)				ACASI (n = 197)			
	Main interview				Main interview			
	No		Yes		No		Yes	
<b>Nurse’s interview (FTF)</b>	%	(n)	%	(n)	%	(n)	%	(n)
No	80.5	(99)	7.4	(8)	76.2	(64)	18.0	(18)
Yes	19.5	(24)	92.6	(100)	23.8	(20)	82.0	(82)

We also investigated the multivariate correlates of discordant reporting between the main interview and the nurse’s interview. As with the internal ACASI analysis of inconsistency discussed above, the results from the logistic regression analysis were not revealing (not shown). As expected, given the results shown in Tables 3a and 3b, interview mode was significant; those interviewed with ACASI were three times more likely to be inconsistent than those interviewed face to face. The only other significant variable was the presence of older male peers in the household. As with the internal ACASI analysis of inconsistency, a respondent was more likely to provide discrepant responses to sexual behavior questions when the household included young men between one and five years older than she. The importance and meaning of these results are not readily apparent.

### **Reporting of sexual behavior and STI status**

One advantage of the Malawi experiment over other survey-based ACASI experiments conducted in developing countries—including our own work in Kenya—is that biomarker data were collected, enabling an investigation of the association between reporting of sexual behavior and STI status by interview mode. Although we don’t know the true underlying association, and our measure of sexual behavior is crude in terms of being a risk factor for infection, we know that misreporting affects the power to detect an association between infection status and sexual behavior by attenuating the observed association toward zero. Thus biomarker data provide an additional opportunity for assessing interview-mode effects.

Before investigating the association between the reporting of sexual behavior and infection status by interview mode, we present descriptive data on STI and HIV prevalence. Table 4 indicates that 2 percent of the total sample tested positive for trichomoniasis, 6 percent for gonorrhea, 1 percent for chlamydia, and 6 percent for HIV. Because the prevalence of these infections is low and given our small sample size, we combine the biomarker data and examine the association between testing positive for at least one of the infections and reported sexual behavior. When combined with HIV, 14 percent of the sample, 17 percent in FTF and 11 percent in ACASI, test positive for one or more STIs and/or HIV.

As mentioned above, only 421 of 501 respondents provided STI and/or HIV samples. Prior to linking the information on sexual behavior to the STI/HIV results, we explore whether those who provided samples are selective in any way that might bias our subsequent analyses. Nonresponse bias is a particular concern in surveys that collect biomarker data, because the validity of prevalence estimates of infection is undermined when those who are sampled are not representative of the population under examination. A multivariate probit analysis of selection bias in the MDICP sample revealed that those younger than 29, males, and those who were more mobile were less likely to participate in testing (Obare 2005).

**Table 4:** Among respondents tested, prevalence of STIs, by interview mode, Malawi, 2004

STI	FTF	ACASI	Total
	% (n)	% (n)	% (n)
Trichomoniasis	2 (180)	1 (219)	2 (399)
Gonorrhea	8 (172)	3 (213)	6 (385)
Chlamydia	1 (172)	1 (213)	1 (385)
HIV	6 (193)	6 (228)	6 (421)
Any STI infection <sup>a</sup>	17 (170)	11 (206)	14 (376)

<sup>a</sup> “Any infection” is defined as testing positive for trichomoniasis, gonorrhea, chlamydia, or HIV.

Selectivity is of particular concern in our sample because the randomization should have produced a more uniform distribution of STIs by interview mode. As is clear from Table 4, a larger proportion of infected respondents was observed in the FTF mode. Table 5 reports the results of logistic regression models estimating the effect of a set of covariates on whether the respondent provided biomarkers for STIs and HIV. In this analysis, the dependent variable is zero only if respondents missed all four STI tests. We evaluate testing status for the full sample and separate the analyses by interview mode to make certain that the characteristics of those tested do not vary by whether a respondent was interviewed by ACASI or FTF. We estimate two models, the first including only those who report ever having had sex based on the broader composite measure. We were particularly concerned that the probability of being tested would vary according to reported sexual behavior. Because sexual behavior is likely to be associated with the other individual and household characteristics, we model its effect separately.

The first set of results in Table 5 for the full sample indicates that those who report having had sex are less likely to have been tested than are those who report ever having had sex based on the composite measure (perhaps because they are reluctant to find out if they are infected); however, the effect is marginally significant at the  $p < 0.10$  level and only for the full sample. No other variables are significantly associated with being tested in the full sample. When analyzed separately by interview mode, some variability is found in the magnitude of effects. Yet only one variable, “older female peers in the household,” is significant at  $p < 0.01$  in the FTF mode and another variable, attendance at religious services, is marginally significant at  $p < 0.10$  in the

**Table 5** Odds ratios from logistic regression models assessing selectivity of respondents tested for any STI or HIV, Malawi, 2004

<b>Model</b>	<b>Full sample</b>	<b>FTF</b>	<b>ACASI</b>
	<b>Odds ratio</b>	<b>Odds ratio</b>	<b>Odds ratio</b>
<b>Model 1: Ever had sex</b>	(n = 501)	(n = 275)	(n = 226)
Ever had sex <sup>a</sup>	0.69†	0.75	0.61
<b>Model 2: Demographic characteristics</b>	(n = 447 <sup>b</sup> )	(n = 236 <sup>b</sup> )	(n = 211 <sup>b</sup> )
Interview mode: ACASI	1.02	—	—
Respondent's age	0.90	0.78	1.04
Respondent's years of schooling	1.01	1.07	0.97
Currently enrolled in school	1.22	1.04	1.44
Ethnicity: Yao	0.88	1.12	0.62
Muslim	1.35	1.16	1.57
Attends religious services at least once per week	1.19	0.80	2.02†
Born again/made tauba	1.00	1.00	0.91
Lives with both parents	1.05	0.83	1.66
Lives with mother	1.02	1.21	0.94
Older male peers in household <sup>c</sup>	1.23	1.66	1.02
Older female peers in household <sup>c</sup>	0.80	0.42**	1.90
Number of people who slept in household previous night	1.00	1.05	1.02
Number of consumer durable items owned <sup>d</sup>	0.94	0.98	0.90

† Significant at  $p < 0.10$ ; \* $p < 0.05$ ; \*\* $p < 0.01$ . — = Not applicable.

<sup>a</sup> Calculated as composite variable: Ever had sex or sex with any partner.

<sup>b</sup> Sample sizes are smaller than full sample because of missing values in the covariates.

<sup>c</sup> Older peers are defined as being between one and five years older than the respondent.

<sup>d</sup> Consumer durables include: furniture, television, radio, telephone, mosquito nets, solar panels, bicycle, motorcycle, car, hoe, and oxcart.

ACASI mode. These results indicate that although about 15 percent of our sample was not tested, we feel reasonably confident that those who provided biomarkers do not differ in any important way from those who did not provide biomarkers, although the differences in prevalence of infection by interview mode remain unexplained.

Table 6 provides the results linking sexual behavior, as reported by our respondents, to infection status. We used only the narrower measure of ever had sex, which was converted to a dichotomous variable from the age-at-first-sex question, because in the nurse's interview the question about type of sexual partners was not asked. As can be seen in the left side of each panel, about 25 percent of FTF respondents and 15 percent of ACASI respondents who reported having had sex tested positive for an STI and/or HIV. This disparity between FTF and ACASI is not surprising because the computerized interview did not generate higher reporting of premarital sex with the age-at-first-sex question.

**Table 6** Percentage distribution of respondents, by infection status, according to whether they reported that they had ever had sex, based on responses to the question about age at first sex and interview mode and type, Malawi, 2004

Infection status	FTF				ACASI			
	Main survey		Nurse's interview		Main survey		Nurse's interview	
	Ever had sex No	Ever had sex Yes						
Tested positive for any STI/HIV								
No	91.7	75.3	91.2	77.4	89.6	85.4	91.7	85.4
Yes	8.3	24.7	8.8	22.6	10.4	14.6	8.3	14.6
(n)	(109)	(97)	(91)	(106)	(115)	(55)	(72)	(89)
Chi-square	10.368**		6.904**		0.606		1.505	

\*\*Significant at  $p \leq 0.01$ .

When we examine the association between ever had sex and infection status using the data generated from the nurse's interview, the results do not differ greatly from the results of the main survey; the association is significant for those interviewed face to face in the main interview, but not for those interviewed with ACASI. When the broader composite measure of ever had sex is used for the main interview data, the association is stronger in ACASI, but still not significant (not shown). Finally, although the association is significant for the FTF group and not for ACASI, in both groups we observe a nontrivial proportion of "virgin" infections, namely young women who deny ever having had sex but who test positive for an infection; interestingly, the proportion of virgin infections varies little for the different interview types (main, nurse) and interview modes (FTF, ACASI).

This analysis linking sexual behavior to infection status, while suggestive, is very crude because we are using a current-status measure of infection rather than a measure of incidence, and a basic measure of sexual activity. Moreover, we have not incorporated additional variables, such as per-coitus condom use, overlapping partnerships, and circumcision status of partners, all of which presumably affect the likelihood of infection.<sup>19</sup>

## CONCLUSION

The experiment we describe here assesses whether the mode of interviewing affects the reporting of sexual behavior among a sample of unmarried adolescent girls aged 15–21 in a rural district of southern Malawi. This paper builds on our earlier research in Kenya where we first investigated whether ACASI provides more accurate data on sexual behavior than face-to-face interviews. The results for Balaka, Malawi are similar to those observed in Kisumu, Kenya. In both sites, the evidence makes clear that the mode of interviewing and use of probing questions about various sexual partnerships affect the reporting of sexual activity. Yet the results are not always in accordance with expectations. Reporting for the first two indicators, "ever had sex" and "sex with a boyfriend," is higher with the FTF than with the ACASI mode; in Malawi, the

difference between the two modes is substantial and significant. When we ask about other partners, however, particularly more stigmatized partners as well as multiple lifetime partners, the reporting is consistently higher with ACASI, in many cases significantly so.

What continues to puzzle us is why the initial question on sexual activity generates higher affirmative responses with the FTF mode than with ACASI. Our sense is that the question is sensitive for unmarried African girls, although perhaps not as sensitive as the other questions. Was our original hypothesis about discomfort in reporting premarital sex in face-to-face interviews without foundation? Or, among African adolescents does ACASI produce its own set of anxieties such that it generates higher reporting only for the most stigmatized of behaviors?

What also intrigues us is why much greater consistency is found in the answers to the initial question and subsequent partner questions in the FTF mode. Both in Kenya and in Malawi, when the partner-specific questions were included to generate a measure of “ever had sex,” the proportion reporting that they had had sex changed little in the FTF group, but increased substantially in the ACASI group. We presented several explanations: interviewer-imposed skips, reconciling of answers by the interviewer, compartmentalizing specific sexual behaviors in the ACASI mode but not in the FTF mode, and unwillingness of the respondent to provide contradictory responses in the FTF mode.

As in Kenya, where the interviewer-administered mode produced more consistent reporting of sexual activity between the main interview and the FTF exit interview, in Malawi the interviewer-administered mode produced more consistent reporting between the main interview and the subsequent FTF interview with a nurse than did ACASI. Although that finding is not unexpected, we did not anticipate the finding that a greater proportion of ACASI respondents who denied having had sex in the main interview subsequently reported having had sex in the later FTF interview.

In linking the reporting of sexual behavior and infection status, we find that the association is positive and significant in the FTF mode and not in the ACASI mode, although in both modes, young women who denied ever having had sex tested positive for STIs/HIV. Because the questions on sexual behavior do not capture STI risk well, and because we measured infection prevalence and not incidence, the results of the biomarker analysis are by no means conclusive.

The conventional notion in survey research is that the more anonymous the interview process, the more likely the respondent is to divulge stigmatized or embarrassing behaviors. The computer can be viewed as the ultimate anonymous interviewer. Yet a recent paper on the “limitations of stranger-interviews” challenges the view that respondents in all settings are more honest with interviewers who are unknown to them. The argument is that, in certain environments where the community is highly suspicious of both outsiders and the research process, respondents are more inclined to be honest when the interviewer is familiar to them. Weinreb (2006:1021) did not conceive of the computer as an alien interviewer—indeed he suggested that ACASI would produce even higher reports of sensitive behavior if it were “introduced to respondents by insider-interviewers”—but maybe some of our adolescent respondents saw the computer as intimidating. Perhaps a computerized interview, which is a highly impersonal encounter, generates greater suspicion than an FTF interview in settings where the technology is unfamiliar. Even so, the strangeness of the technology and the impersonal

nature of a computerized interview do not answer the question as to why ACASI produces higher reports for some sensitive behaviors and not for others among adolescents in Kenya and Malawi.

Although we would like to believe that computerized interviewing improves the quality of data on sensitive behavior among African adolescents, this analysis from Malawi, like our earlier analysis from Kenya, raises as many questions as it answers. The results from our methodological experiments in Africa as well as comparable experiments conducted by researchers in India and Vietnam emphasize the necessity of treating survey data on adolescents' sensitive behaviors with skepticism. Findings from our research among older women in Brazil are less ambiguous and support the expectation that computerized interviewing produces data of greater validity (Hewett et al. 2006; Mensch et al. 2007). Previously, we called for more quantitative studies on interview-mode effects, as well as qualitative research on the interaction between interviewers and respondents and on reactions to the computer among developing country populations. Because behavioral data are so important both for understanding the etiology of the AIDS pandemic and for understanding the results of clinical trials that assess the efficacy of products and technologies to reduce the transmission of sexually transmitted infections, we continue to advocate for more research in this area.

**Appendix Table 1** Logistic regression models by measure of sexual behavior

Variable	Ever had sex		Composite: Sex with any partner		Composite: Ever had sex or sex with any partner	
	Odds ratio	Odds ratio	Odds ratio	Odds ratio	Odds ratio	Odds ratio
	(n = 500)	(n = 466)	(n = 500)	(n = 447)	(n = 500)	(n = 447)
ACASI interview mode	0.54**	0.38**	1.03	0.98	1.34*	1.36†
Respondent's age		1.30**		1.23*		1.30**
Respondent's years of schooling		1.20*		1.23*		1.25*
Currently enrolled in school		0.21**		0.24*		0.22*
Ethnicity: Yao		1.23		1.35		1.33
Muslim		1.00		1.27		1.16
Attends religious services at least once per week		0.67†		0.58†		0.60†
Born again/made taube		1.30		1.21		1.27
Lives with both parents		0.80		0.80		0.85
Lives with mother		1.72		1.77*		1.75†
Older male peers in household <sup>a</sup>		0.88		1.20		1.36
Older female peers in household <sup>a</sup>		0.82		0.45**		0.54**
Number of people who slept in household previous night		1.04		1.01		0.98
Number of consumer durable items owned <sup>b</sup>		1.04		1.05		1.03

† Significant at  $p < 0.10$ ; \* $p < 0.05$ ; \*\* $p < 0.01$ .

<sup>a</sup> Older peers are defined as being between one and five years older than the respondent.

<sup>b</sup> Consumer durables include: furniture, television, radio, telephone, mosquito nets, solar panels, bicycle, motorcycle, car, hoe, and oxcart.

## NOTES

- 1 This suggestion has generated considerable attention from epidemiologists. In a recent article, French and her colleagues (2006) produce simulations revealing that unrealistic assumptions about unsafe medical injections would be required to produce the current HIV pandemic in Africa, whereas plausible average partner-change rates are compatible with the current pandemic. See also Hayes and White (2006).
- 2 “Interviewer autonomy” refers to interviewers’ failure to follow the interview protocol. “Respondent autonomy” refers to respondents’ controlling the information provided to the interviewer.
- 3 An “assisted self-completion questionnaire” (ASCQ) has been used instead of a self-administered questionnaire when the population is semiliterate (see Mensch et al. 2001 and Plummer et al. 2004). For this form of administration, a research assistant reads the questions to a group and waits as each respondent records his/her answer. A comparison between ASCQ and an FTF interview for the same set of adolescent respondents in Tanzania revealed considerable inconsistency for questions about sexual behavior.
- 4 Random-response techniques may prove useful for estimating the prevalence of a particular behavior; they cannot be used for analyses of the determinants and consequences of the behavior, however, because the data cannot be linked to specific individuals.
- 5 Respondents were asked about sexual partnerships even if they responded “no” to the initial question about ever having had sex.
- 6 For additional project information, go to <<http://www.malawi.pop.upenn.edu>>.
- 7 The 501 adolescents were added to the approximately 1500 young people included in the third wave of the MDICP.
- 8 A small number of respondents interviewed were aged 14 or 22, beyond the designated age range; we retained them for the analysis because of the small sample size.
- 9 Reagents were ordered from the United States, and restrictions were placed on the amount that could be ordered at one time. Supervisors were sent to the homes of all village headmen to inform them about the delay in communicating results of the testing (Anglewicz et al. 2005).
- 10 They were given ciprofloxacin for gonorrhea, if they were not pregnant, and azithromycin if they were pregnant, metronidazole for trichomoniasis and azithromycin for chlamydia (Bignami-Van Assche et al. 2004).
- 11 For more information on the STI/HIV testing procedures and the communities’ reactions, see Bignami-Van Assche et al. (2004); Anglewicz et al. (2005); and Thornton et al. (2005).

- 12 Although more than half of the ACASI respondents were Yao, a much smaller proportion chose to be interviewed in the Yao language. Unlike Chichewa, the main indigenous language, which is both written and spoken, Yao is primarily oral.
- 13 Estimates of standard errors were adjusted for clustering.
- 14 No “don’t know” option was available in either survey mode for this question, nor did any script ask the respondent to estimate her age at first sex if she could not remember it. Given the age range of our sample, it is unlikely that a respondent would not remember her age at first sex. Only one value is missing for this question.
- 15 Appendix Table 1 provides the odds ratios for all variables included in the three ever-had-sex models generated for Malawi, that is, the ever-had-sex model based on the initial question, and the models based on the two composite measures.
- 16 Only the ACASI program allowed respondents to return to the previous question.
- 17 In a subsequent survey of Malawian adolescents in 2007, where sensitive questions were asked using ACASI, we included interviews with respondents about their attitude toward and anxieties about computerized interviewing.
- 18 Direct comparison of reporting of sexual partners is not possible because the questions about partners were not asked in the nurse’s interview.
- 19 Although we do not have data on the circumcision status of the partners of adolescent girls, we could use ethnic group as a proxy. According to data from the MDICP women’s sample, between 80 and 90 percent of Yao partners are circumcised, compared with less than 15 percent of non-Yao partners. Unlike the situation in other sub-Saharan African countries, in Malawi the association between circumcision status of men and HIV is positive (National Statistical Office and ORC Macro 2005), which suggests that those who are circumcised are engaging in behaviors that put them at higher risk.

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